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Did you say Supply Chain Digital Twin?
Demystifying Digital Twins and their potential in Supply Chains

February, 2023

MAKING AN
IMPACT THAT
MATTERS
since 1845

Agenda

"We cannot solve problems with the same thinking that created them"

Albert Einstein

Introduction

As global dynamics are becoming more turbulent, technology innovation more disruptive and environmental sustainability ever more imperative, supply chain leaders are facing unprecedented challenges. But is Digital Twin the silver bullet?

What is a Digital Twin?

It was on the rainy track of the Grand Prix in Monte Carlo that McLaren managed to snatch the race despite a huge setback: a tire exploded. The commentators sounded chaotic as a lot was happening at the same time. On the other side, through the headsets of the McLaren team, there was complete calmness. Everybody knew exactly what to do, and the driver only received a few relevant instructions. Teams like McLaren leverage Digital Twin analytics to prepare these scenario's and quickly calculate the best strategic response. This is a great example of a Digital Twin, the ability to develop a digital representation of reality and then fast forward to likely future scenarios through cloud-enable analytics leveraging the latest analytics methodologies. Digital Twins not only help determine an optimal strategy upfront but also allow to react very quickly to changing circumstances. Be prepared for what is about to happen rather than react to it.

Evolve or brace for impact

The key challenge at the heart of supply chain management is the complex problem of reconciling two conflicting objectives: maximizing customer service while minimizing cost. Currently this task has become significantly more complex, as the world is increasingly globalized and interconnected, consumers are more demanding, the energy transition is imperative, and geopolitical dynamics are ever more turbulent.

The use of advanced analytics and control towers to help make complex decisions is nothing new to supply chain leaders. So, what is the buzz around Digital Twin technology?

What sets Digital Twin apart?

The differentiator of Digital Twin technology is the AI/ML intelligence engine, deployed on a digital replica of real-world assets and processes, integrating large datasets coming from a diverse set of systems, powered by cloud technology. Digital Twin technology will enable the next generation of prescriptive and immersive control towers with use cases that will increasingly evolve in the tactical and strategic domain.

The AI/ML intelligence engine deploys cutting edge AI based algorithms such as reinforcement learning, statistical learning and Bayesian Optimization. This allows to reach better decisions faster compared to traditional Operations Research methodologies. Cloud-enabled analytics allow to stream near real time data for unprecedented insights.
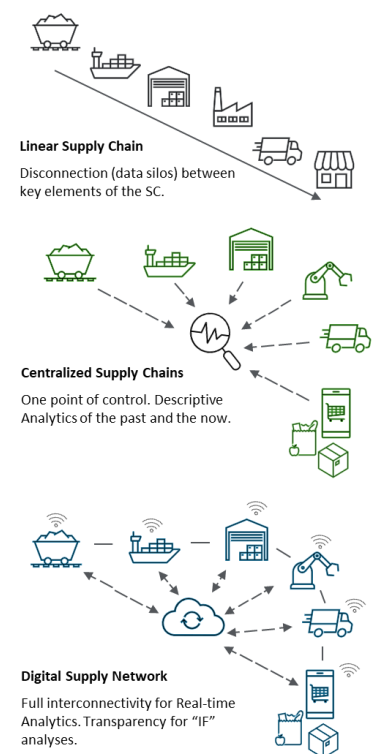
These innovations open the possibility to include a new variable in the optimization: environmental footprint. This enables companies to accelerate their sustainability agenda.

Descriptive control towers give transparency in the past and in the now, whereas prescriptive control towers, powered by Digital Twin technology, give transparency in the future "WHAT IF" states.

Your journey, our partnership

At Deloitte we have the right expertise, leveraging our IDO framework, to help you on your maturation journey to deploy and reap the benefits of Digital Twin technology.

Linear Supply Chain
Disconnection (data silos) between key elements of the SC.

Centralized Supply Chains
One point of control. Descriptive Analytics of the past and the now.

Digital Supply Network
Full interconnectivity for Real-time Analytics. Transparency for "IF" analyses.

Demystifying Digital Twins

Supply chain organizations have been for a long time on a journey to advanced analytics capabilities that support the shift from linear Supply Chain to Digital Supply Network. Digital Twin is the technology that will enable the ultimate step in this evolution

Are Digital Twins a new name for control towers?

We don't believe so. Control towers are typically deployed to support operational decision making; and generally focus on a specific selection of the supply chain.

Digital Twins are a technology that enable broader applications spanning into the tactical and strategic domain. Through advanced scenario modeling capabilities, they enable advanced decision making in situations such as near-real time network design and logistics optimizations. The agility of Digital Twins, leveraging new techniques such as deep reinforcement learning, cloud technology and near real-time data sets, sets it apart from both traditional control tower solutions as well as off the shelf optimization and simulation solutions.

Maturity staircase to Digital supply network

Supply chains have evolved from being linear to digital supply networks. To understand the potential and demystify Digital Twins, it is important to look at the analytics capabilities maturity journey.

1. Department Excel files

Traditionally supply chains were run by siloed departments responsible for their own set of KPIs with limited visibility across departments. Each department individually could optimize these processes, but had limited visibility on impact of decisions on other steps in the value chain

In terms of performance management, this was done mainly in department Excel files and manual reports tailored to specific business user needs

2. Descriptive level

Technology advancements result in increased generation of operational data and enable a better exchange of operational data. This has enabled the emergence of control towers, attempting to connect all departments to one point of control with visibility across departments. This allows for better end-to-end decision making

Early control towers provided visibility on a sub-set of the total supply chain. This was already a big improvement from the traditional siloed thinking. In our ever-connected world, Control Towers have become more sophisticated and are able to represent SC performance in (near-) real time. However, Control towers are typically focused on representing current and past performance without a direct call to action.

3. Predictive level

With predictive capabilities comes the opportunity to formulate an expectation of the most likely event. Predictive modeling provides additional decision-making support. Supply Chain professionals not only see what happened, but also get an "informed" opinion by an algorithm on what is likely to happen.

What is the expected loading/unloading time of a specific set of customers? What is the most likely required

workforce capacity in my warehouse next week or month? Based on these insights, supply chain professional need to rely less on gut feeling or personal experience and can base their decisions on more rational levers.

At this maturity stage we may start to see simple Digital Twin capabilities. In order to generate predictive analytics for certain processes, it may be the case that a Digital replica of an asset or processes is created. However, as already mentioned those are cases of simple Digital Twin technology deployments. The really advanced cases unlocking unprecedented value occur in the prescriptive level.

4. Prescriptive level

At the prescriptive level several limitations of predictive modeling are overcome and additionally professionals are not only provided with information on what might happen, but also with a recommendation on the best action to take.

Predictive models often provide a point estimate, a single number, sometimes accompanied by a confidence interval that usually has marginal value add. Moreover, this point estimate is based on a calibration period that is typically restricted to recent history to predict the future.

In prescriptive modeling, the insights generated are sets of possibilities rather than point estimates. Moreover, these sets of possibilities are more representative of the entire history.
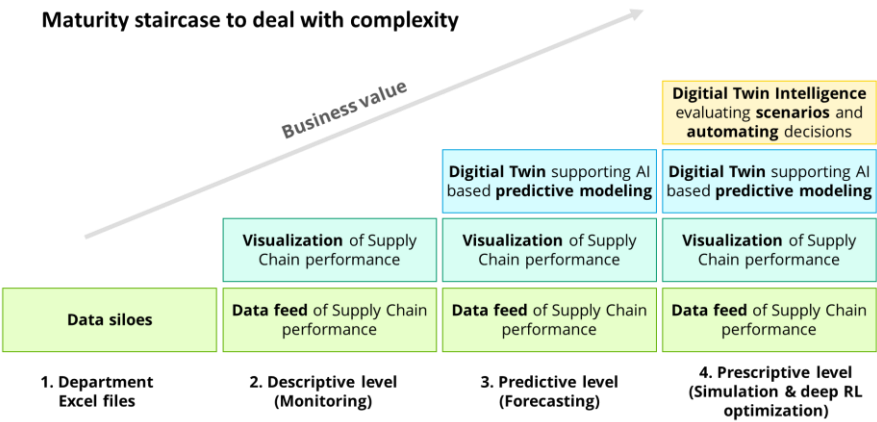
Algorithms such as deep reinforcement learning iterate over time through sets of possibilities and learn what is the best course of action in each possibility set. By doing so they are able to generate a recommendation for supply chain professionals, who now not only have a prediction for the future, but are also provided with a recommendation on what to do next.

It is in the prescriptive modeling domain that Digital Twins play a determining role.

Advanced simulation-based analyses deployed on a data-rich digital replica, allow to generate different states of the world and provide a richer analysis set then conventional predictive analytics capabilities.

Reinforcement learning algorithms trained on historical events through the digital replica, allow to generate recommendations for the best action available in the action space.

The combination of these two elements is a powerful decision-making tool now available to supply chain professionals.

Maturity staircase to deal with complexity

Business value

1. Department Excel files	2. Descriptive level (Monitoring)	3. Predictive level (Forecasting)	4. Prescriptive level (Simulation & deep RL optimization)
			Digitial Twin Intelligence evaluating **scenarios** and **automating** decisions
		Digitial Twin supporting AI based **predictive modeling**	**Digitial Twin** supporting AI based **predictive modeling**
	Visualization of Supply Chain performance	**Visualization** of Supply Chain performance	**Visualization** of Supply Chain performance
Data siloes	**Data feed** of Supply Chain performance	**Data feed** of Supply Chain performance	**Data feed** of Supply Chain performance

Advanced decision making across different horizons

Digital Twins provide operational, tactical and strategic opportunities
for both incremental and radical improvements in your Supply Chain

Digital Twins at different horizons
Digital Twins support optimized decision making on operational, tactical and strategic levels.

1. Operational
On an operational level smart algorithms can improve and automate operational processes and decisions. This will result in quicker and better decisions than individual planners are able to make manually. Almost all steps in the supply chain where decisions are made, can be improved and automated. Some examples are:

- A global manufacturing can use a Digital Twin to anticipate or quickly adjust its manufacturing plan based on disruptions at a 2nd tier supplier
- A global retail can use Digital Twin to determine how to best liquidate certain products against the highest margin
- The local distribution team can adjust route to market due to Warehouse constraints

2. Tactical
On a tactical level, the scenario modeling capability of Digital Twins can support making quick tactical decision that improve the performance of their supply chain:

- A global retailer can use Digital Twin to reallocate inventory between warehouses based on actual and forecast demand.
- Additionally, it can determine new target stock levels based on changes in market behavior

3. Strategic level
On a strategic level, Digital Twins can be used to simulate countless different supply chain scenarios, some examples:

- A FMCG company can use their Digital Twin to achieve highest savings by opening a new distribution center
- A car manufacture can make an assesment of the impact of potential supply disruptions
- An industrial products manufacturer may change source base to lower CO_2 emissions, or change product/mix allocation to hit sustainability targets

Maturity
The realization of the Digital Twin's full promise requires integrating processes, systems and data across entire ecosystems. The journey to the digital twin's full potential goes through different maturity stages *(see framework on next page).*

For example, consider the operational management of a Fullfilment center. At each maturity level, more value is unlocked in supporting operational steering

On a **descriptive level** Digital Twin technology provide insight in operational performance. A dashboard will provide real-time insights on the fulfilled orders compared to plan, it provides an overview of current and expected stock levels, the order backlog and productivity across different process steps like picking, packing and outbound. This visibility helps management to take operational interventions

On a **predictive level**, a Digital Twin will help the operational team to forecast the number of orders the fulfillment center needs to handle ahead of time. This can be based on actual orders placed, but also marketing plans and potential external factors influencing expected consumer orders.

On a **prescriptive level**, Digital Twins will prescribe operational managers how to act upon the insights provided by the Digital Twin. Powerful scenario modeling engines can create workforce schedules based on the expected capacity need. The Digital Twin can also suggest reordering specific SKUs when it predicts stock-outs. When a prescriptive Digital Twin is working well enough, it has the potential to completely take-over the many operational management tasks on it owns

Digital Twin & Sustainability
Digital Twin technology enables capabilities specifically aimed at sustainability improvements, such as waste tracking. But even more exciting is the opportunity to formulate any decision by taking sustainability as one of the parameters in the optimization equations. And this will apply for each of the other use cases presented.

Maturity and decision horizon framework

Tactical

Operational

Strategic

SUSTAINABLE MAINTENANCE

AUTOMATED & ADAPTIVE REAL-TIME PRODUCTION LINE OPTIMIZATION

THROUGHPUT SIMULATION

OPTIMIZE PRODUCTION PLAN

MINIMIZE WASTE

ADAPTIVE PREVENTIVE MAINTENANCE

ROUTE OPTIMIZATION

ADAPTIVE OPTIMIZED REROUTING

PREDICT MACHINE FAILURE

CALCULATE IDEAL SAFETY STOCK

MAXIMIZE MACHINE LIFECYCLE

SCENARIO MODELLING

DEMAND FORECASTING

NETWORK DESIGN

IMPROVED RESOURCE PLANNING & WORKLOAD ALLOCATION

STOCK LEVELS MONITORING

MONITORING DELAYS, QUEUES, MACHINES

DURABILITY ANALYSIS

OPTIMIZE ENERGY USAGE

SIMULATE IMPACT HIGH - / LOW – DEMAND ON COSTS

VEHICLE TRACKING

WASTE TRACKING

MONITOR MACHINE LIFE CYCLE

TREND & PATTERN ANALYSIS

SUSTAINABLE NETWORK OPTIMIZATION

MACHINE USAGE SIMULATION

ENERGY CONSUMPTION MONITORING

GOODS TRACKING

ADAPTIVE ORDERING AND RE-STOCKING

REAL-TIME ENVIRONMENTAL TEMPERATURE

EMISSIONS MONITORING

Data Siloes

Sustainability Impact

Descriptive   **Predictive**   **Prescriptive**

Low   Sufficient   Intermediate   High

Maturity

How to implement

Implementing a digital twin successfully can be challenging as in the case of any advanced analytics technology implementation. Having the right methodology and approach is essential.

Start small, learn, scale fast
In general organizations struggle with the implementation and adoption of advanced analytics technologies. Starting small with the right scope and then scaling up is the key to success. We advise clients to start piloting the digital twin with a limited scope and defined strategic goals. This allows to quickly show the value a Digital Twin can bring and provides learning that can be incorporated when scaling. Then scale up the product either in complexity or in organizational scope. A combination of the agile methodology and Pods staging allow for a fast, scalable, and multi-disciplinary approach. In our experience with a clear target and successful methodology you can start scaling up the digital twin at pace in a stabilized, fast and mature way.

Consider Insight Driven Organization
Our secret sauce when it comes to advanced analytics transformation is Deloitte's Insight Driven Organization framework. The five pillars will guide in achieving strategic focus and alignment, scoping and prioritizing based on as-is capabilities, deploying a value-adding and sustainable advanced analytics solution in the organization. There is no one size fits all approach, and every client needs a tailored approach to their journey to achieve rapidly results in an incremental and agile way.
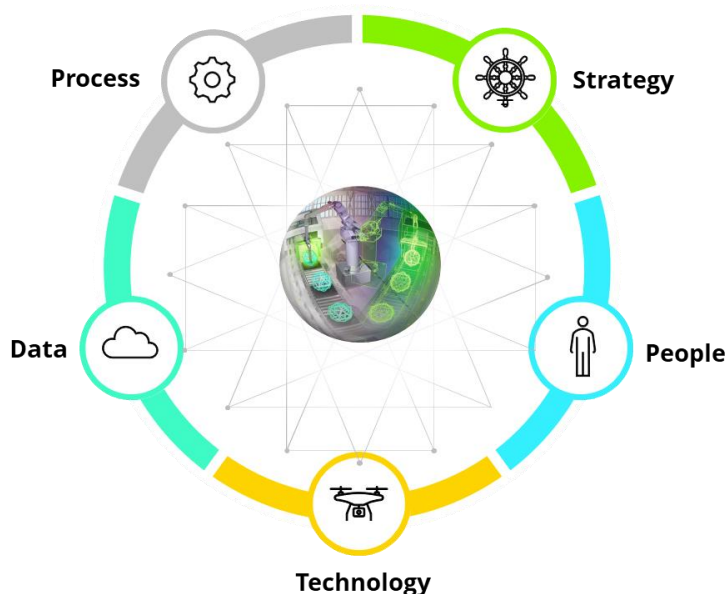
Acknowledging the cross-functional interdependencies and **processes** that exist for a Digital Twin solution

Align the analytics roadmap to the company's vision, enable the analytics **strategy**, and thereby bring value with analytics

Investing in **people's** skills, reflecting on their behavior and organizing them for success

Technology is an enabler of the analytics capability, it needs to be fit for purpose, future-proof, able to scale as required

Without good **data**, analytics is garbage-in and garbage-out. To have good data companies need good data governance and strategy

Process

Strategy

Data

People

Technology

Consequence of Unbalance
Neglecting even one of the five pillars with results in an unsuccessful transformation

For Example

1. **Neglecting the people dimension** often leads to a solution that is either not being adopted because users don't trust it; or a situation where a product quickly fades out as there is no capability to maintain and mature it

2. **Neglecting the process dimension** can lead to insights that do not trigger the desired workflows and outcomes; after predicting that something might happen it's necessary that the right business process is triggered to act on the decision

3. **Neglecting the data dimension** is very tricky; it has happened that after analytics projects the lack of data governance resulted in bad quality data through the system and meaningless insights generated

Contacts

Our team can help discover and solve Digital Twin opportunities in your business, please reach out!

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